

Chapter 4

Remedial Progress

The Agency's progress during FY94 illustrated its commitment to accelerating and completing cleanups at Superfund sites. The Agency started more than 120 remedial actions (RAs) to construct remedies, and completed construction activities to place 61 sites in the construction completion category. To date under the Superfund program, the Agency has completed clean-up activities to place a total of 278 National Priorities List (NPL) sites in the construction completion category. This chapter describes this and other examples of remedial progress during the year. Specifically, this chapter provides information on

- FY94 progress in remediating NPL sites;
- Remedial initiatives;
- Remedies selected during the year;
- Efforts to develop and use innovative treatment technologies, including an evaluation of newly developed and achievable permanent treatment technologies, as required by CERCLA Section 301(h)(1)(D); and
- Results of five-year reviews under CERCLA Section 121(c) at sites where contamination remained after the initiation of the RA.

4.1 REMEDIAL PROCESS

The remedial process complements the removal process (see Chapter 3) by addressing more complicated, long-term evaluation and response for hazardous waste sites on the NPL. The remedial process is preceded by the site evaluation process,

which consists of the discovery or identification of a potential site, the preliminary assessment of the site, and the site inspection (SI). During the SI, the site is evaluated for possible listing on the NPL. If a site is listed on the NPL after the SI, the Trust Fund can be used to finance clean-up activities at the site under the remedial authority of CERCLA.

The remedial process to clean up NPL sites is comprised of the following activities:

- The remedial investigation/feasibility study (RI/FS) to determine the type and extent of contamination and to evaluate and develop remedial clean-up alternatives;
- The record of decision (ROD) to identify the remedy selected, based on the results of the RI/FS and public comment on the clean-up alternatives;
- The remedial design (RD) to develop the plans and specifications required to construct the selected remedy;
- The RA to implement the selected remedy, from the start through the completion of construction of the remedy; and
- Operation and maintenance (O&M) to ensure the effectiveness and/or integrity of the remedy. O&M occurs after implementation of a response action.

A Remedial Project Manager (RPM) oversees all remedial activities and related enforcement activities. Regional coordinators at EPA Headquarters assist RPMs by reviewing remedial and enforcement activities and by answering technical and policy questions.

4.2 FISCAL YEAR 1994 REMEDIAL PROGRESS

The Agency's progress during the fiscal year in initiating RAs and completing construction activities to classify sites as construction completions indicates its continuing commitment to accelerate the cleanup of NPL sites. By the end of FY94, work had occurred at 94 percent of the 1,355 NPL sites. Sites deleted from the NPL reflect an activity required to be reported. Exhibit 4.2-1 illustrates the status of the work at NPL sites, showing sites by the most advanced stage of activity accomplished. The following sections of this chapter highlight progress made at the sites during FY94.

4.2.1 Construction Completions

Responding to the recommendations of the 1991 30-Day Study and the 1993 Superfund Administrative Improvements Task Force, the Agency has worked

to accelerate and complete cleanup at NPL sites. The Agency completed construction activities at 61 sites during FY94, bringing the total number of sites in the construction completion category to 278. This exceeded the recommended FY94 target of 265. More than 78 percent of the construction completions have been achieved in the past three years.

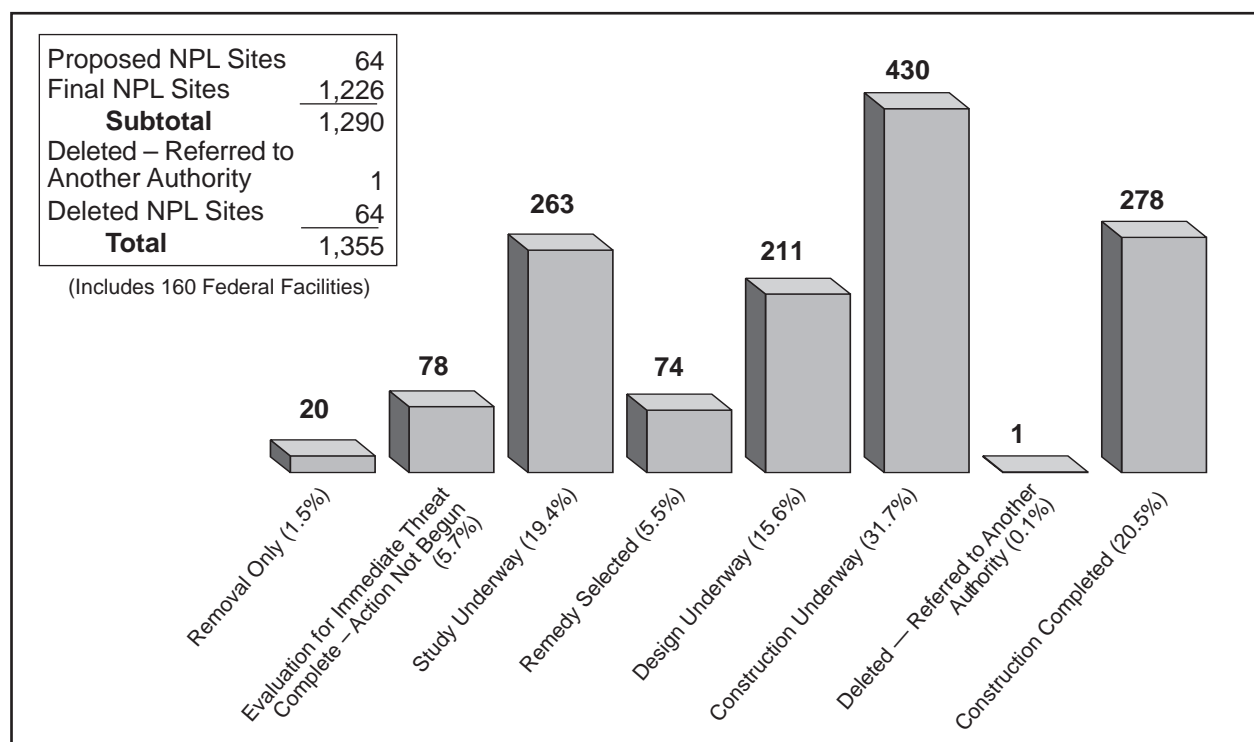
4.2.2 New Remedial Activities

As shown in Exhibit 4.2-2, the Agency or potentially responsible parties (PRPs) had undertaken approximately 1,670 RI/FSs, 1,230 RDs, and 850 RAs since the inception of the Superfund program through the end of the FY94.

The remedial activities started during FY94 reflect the Agency's emphasis on accelerating the pace of cleanup and focusing resources on RAs. New remedial activities undertaken this fiscal year include

- *RI/FS Starts:* The Agency or PRPs started nearly 70 RI/FSs during FY94, including nearly 40 (60 percent) financed by EPA and more than

Exhibit 4.2-1
Work Has Occurred at 94 Percent of the National Priorities List Sites



Source: CERCLIS.

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30 (40 percent) financed by PRPs. In FY93 the Agency or PRPs started nearly 60 RI/FSs, including more than 30 (60 percent) financed by EPA and more than 20 (40 percent) financed by PRPs.

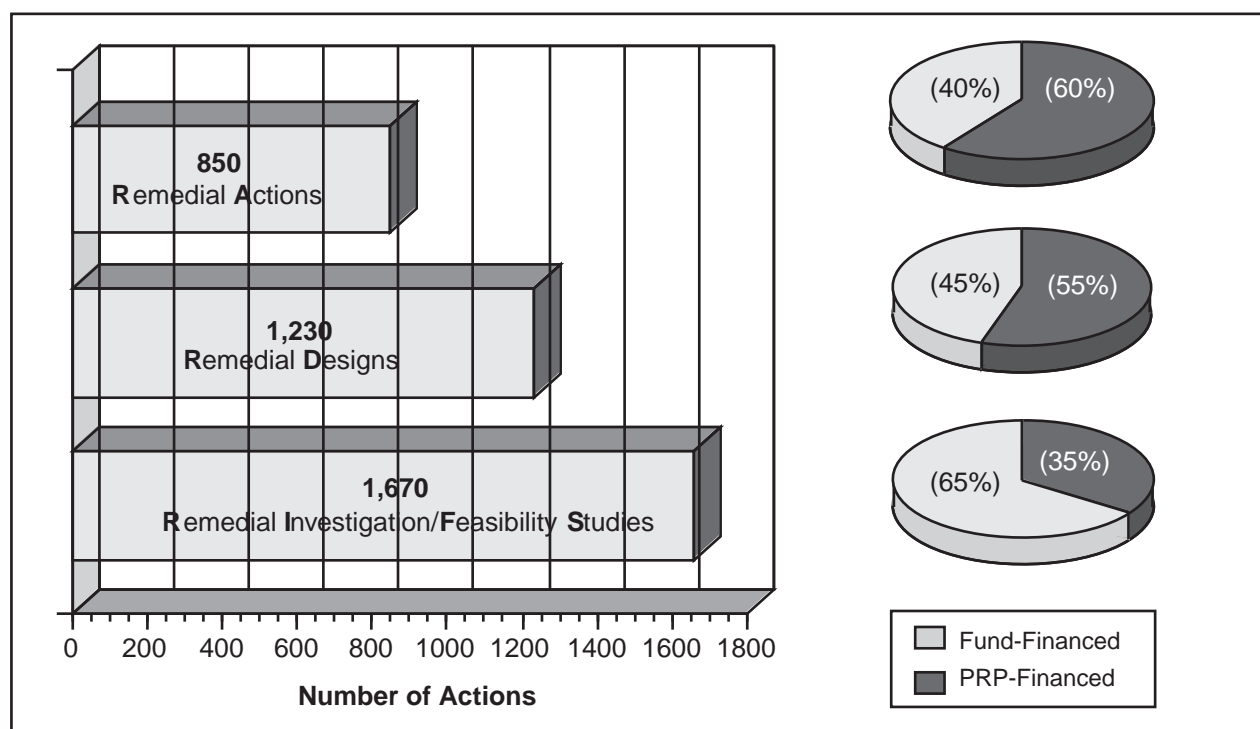
- **RD Starts:** The Agency or PRPs started approximately 110 RDs during FY94, including nearly 30 (25 percent) financed by EPA and more than 80 (75 percent) financed by PRPs. In FY93 the Agency or PRPs started approximately 130 RDs, including nearly 50 (40 percent) financed by EPA and more than 80 (60 percent) financed by PRPs.
- **RA Starts:** The Agency or PRPs started more than 120 RAs during FY94. EPA was financing approximately 30 (20 percent) and PRPs were financing more than 90 (80 percent). In FY93, the Agency or PRPs started approximately 120 RAs, including nearly 30 (25 percent) financed by EPA and 90 (75 percent) financed by PRPs.

4.2.3 Status of Remedial and Enforcement Activities in Progress

At the end of FY94, 1,767 RI/FS, RA, and RD projects were in progress at 867 sites, compared to 1,750 RI/FS, RA, and RD projects in progress at 910 sites at the end of FY93. Projects in progress at the end of FY94 included 1,320 RI/FS and RA projects and 447 RD projects. As required by CERCLA Sections 301(h)(1)(B),(C), and (F), a listing of the RI/FS and RA projects in progress at the end of FY94 is provided in Appendix A, along with a projected completion schedule for each project. A listing of all RDs in progress at the end of FY94 is provided in Appendix B.

Of the 1,320 RI/FS and RA projects in progress at the end of FY94, 54 percent were on schedule, ahead of schedule, started during the fiscal year, or

Exhibit 4.2-2
Remedial Accomplishments Under the Superfund Program
for Fiscal Year 1980 Through Fiscal Year 1994



Source: CERCLIS.

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had no previously published completion schedule, and 46 percent were behind schedule. These projects include 299 on schedule, 51 ahead of schedule, 276 started during the fiscal year, 90 that had no previously published completion schedule, and 604 that were behind schedule. Exhibit 4.2-3 compares the number of projects in progress at NPL sites at the end of FY93 with the number in progress at the end of FY94, by lead.

PRPs were conducting 441 of the RI/FS and RA projects in progress at the end of FY94, including 202 RI/FSs and 239 RAs. Of these 441 PRP-financed projects, 51 percent were on schedule, ahead of schedule, started during the fiscal year, or had no previously published completion schedule, and 49 percent were behind schedule. Projects include 82 on schedule, 9 ahead of schedule, 117 started during the fiscal year, 19 that had no previously published completion schedule, and 214 that were behind schedule.

The status of RI/FSs and RAs in progress at the

end of the fiscal year is based on a comparison of each project's planned completion date in the CERCLA Information System (CERCLIS) at the end of FY93 with the planned completion date in CERCLIS at the end of FY94. An initial completion schedule is included when a remedial activity is entered into CERCLIS. Minimal site-specific information is available when the initial completion schedule is determined by the Regions, and they usually rely on standard planning assumptions (e.g., 12 quarters for an RI/FS). As work continues, Regions adjust schedules for projects to reflect actual site conditions.

4.3 REMEDIAL INITIATIVES

As recommended by the 1993 Superfund Administrative Improvements Task Force, EPA continued several efforts to streamline remedial activities and increase the consistency and efficiency in Superfund cleanups. EPA's FY94 efforts included

Exhibit 4.2-3
Projects in Progress at National Priorities List Sites by Lead
for Fiscal Year 1993 and Fiscal Year 1994

	RI/FS		RDs		RAs	
	FY93	FY94	FY93	FY94	FY93	FY94
Fund-Financed—State-Lead	28	21	25	26	26	28
Fund-Financed—Federal-Lead ¹	145	160	107	108	95	98
Fund-Financed—EPA Performs Work at Site ²	21	11	4	4	3	2
PRP-Financed and PRP-Lead	219	204	238	242	186	222
Mixed Funding—Monies from Fund and PRPs	0	1	1	2	9	7
PRP-Financed—State Order and EPA Oversight ³	45	27	23	16	21	25
State Enforcement	2	2	1	2	0	0
Federal Facility	459	485	46	56	46	75
Total	919	911	445	456	386	457
¹ Includes remedial program-lead projects and enforcement program-lead projects. ² Projects at which EPA employees, rather than contractors, perform the site clean-up work. ³ Projects where site clean-up work is financed and performed by the PRPs under state order, with EPA oversight.						

Sources: *Progress Toward Implementing Superfund*: FY93 (Appendices A and B) and FY94 (Appendices A and B).

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developing presumptive remedies, establishing soil screening levels (SSLs), and implementing guidance on dense non-aqueous phase liquid (DNAPL) contamination and on the technical impracticability (TI) waiver.

4.3.1 Presumptive Remedies

The Agency is developing presumptive remedies to streamline the remedy selection process for certain categories of sites. The objective of the presumptive remedy initiative is to use the program's past experience to streamline site investigation and speed up identification of appropriate clean-up activities. Presumptive remedies can foster consistency in remedy selection and reduce the cost and time required to clean up similar types of sites.

During FY94, the Agency monitored the implementation of presumptive remedies at seven sites. At these sites, the Agency piloted the presumptive remedies developed for municipal landfills and sites contaminated with volatile organic compounds (VOCs). The seven projects included five municipal landfills and two sites with VOC contamination in soil.

Forexample, EPA selected the BFI-Rockingham Landfill NPL site in Rockingham, Vermont, as a national pilot for the evaluation of the presumptive remedy guidance for CERCLA municipal landfill sites. The Agency used existing historical data to streamline the risk assessment and RI/FS and to establish an initial basis for action. The Agency further accelerated the RI by eliminating a complete chemical characterization of the landfill, focusing instead on collecting geotechnical information (i.e., landfill cover quality and soil settlement and stability) needed for designing the source control remedy recommended as the presumptive remedy. PRPs undertook a non-time-critical removal action to begin implementing components of the presumptive remedy, including a landfill cap. By quantifying potential ground-water risks and other pathway risks during the RI/FS, the Agency also streamlined the RA for actions outside the scope of the presumptive remedy (i.e., ground-water and surface-water cleanup).

Using a presumptive remedy approach at the BFI-Rockingham Landfill site decreased the time period from RI/FS start to construction initiation from the typical 5 to 8 years to 2 years. In addition, the Agency reduced the time period from RI/FS start to ROD signing for those activities outside the scope of the presumptive remedy from the typical 3 to 5 years to 2 years.

The Agency is also working to develop additional presumptive remedies for wood-treater, polychlorinated biphenyl (PCB)-contaminated, manufactured gas plant, grain storage, and contaminated ground-water sites. The Agency will continue efforts to develop these presumptive remedies and identify demonstration sites. The Agency will also monitor the demonstration projects and integrate the results into additional guidance on the use of presumptive remedies.

4.3.2 Soil Screening Levels

To facilitate investigation and cleanup of soil contamination, EPA continued efforts to develop SSLs. SSLs identify contaminant levels below which there typically is no concern and above which further site-specific evaluation is warranted. Generally, where chemical concentrations fall below the SSL, no further federal action or study would be required, provided that the risks posed by the site are only for those pathways addressed by the soil screening guidance. If other risks are posed, such as ecological risks, the site may require further study. Levels above the screening level would not automatically trigger an RA or cause a site to be designated as "contaminated" but would indicate that further evaluation of the site was required.

EPA continued to work on the soil screening guidance that will provide guidelines for developing risk-based, site-specific SSL values. The SSL values can be compared to samples taken from a site to determine whether a site poses a risk from a soil contaminant and would warrant further study. The soil screening guidance will assist in focusing investigation efforts on significant contaminants and exposure pathways of concern. The guidance will also provide a standard method of ruling out certain

areas of a site from further concern and study.

During FY94, the Agency held numerous outreach meetings with the Department of Energy (DOE), Department of Defense (DOD), Department of Housing and Urban Development, lenders, auditors, insurers, industry, and environmental groups to discuss SSLs. In addition to the stakeholder meetings, the Agency met frequently with Association of State and Territorial Solid Waste Management Officials, who represent state interests.

The Agency conducted several projects to technically evaluate the exposure pathways and sampling methods proposed in the guidance. For example, EPA completed a pilot study of 10 sites. From the results, the Agency determined that exposure pathways used in the guidance are sufficient to model exposure pathways of residential areas and that additional exposure pathways do not need to be incorporated into the SSL process. The Agency also initiated a SSL demonstration project to verify that the sampling methods described in the draft guidance are adequate. Through the project, the Agency will analyze soil obtained from a Superfund site using the proposed sampling methods.

Based on stakeholder input and the technical analyses, the Agency revised the draft soil screening guidance and, in August 1994, distributed a revised draft of the guidance to Regions and the states for additional review. The August 1994 draft of the soil screening guidance established threshold levels for 100 chemical concentrations in soil that warrant site-specific study of risks. On December 30, 1994, the Agency also published a Notice of Availability of the draft soil screening guidance in the *Federal Register* to solicit further public comment.

EPA began developing an outreach document for the general public to explain the soil screening process in clear and concise language. EPA also asked community groups to comment on the clarity of the draft soil screening guidance for a non-technical audience.

4.3.3 Addressing Technical Complexities of Ground-Water Cleanup

EPA continued to evaluate technical and policy solutions that are designed to address the pervasiveness of DNAPL contamination in ground water. DNAPLs are contaminants, such as chlorinated solvents, that have extremely complex characteristics, do not mix with water, and typically accumulate at the bottom of a contaminated ground-water source. Because of these characteristics, DNAPLs are difficult to detect and complicate the cleanup of ground water. Agency research indicates that approximately 85 percent of all Superfund sites have ground-water contamination, and 60 percent of all Superfund sites are likely to have DNAPL contamination.

To address the technical difficulties associated with DNAPL contamination, the Agency continued to develop a comprehensive strategy for detecting and addressing the contamination. The strategy focuses on locating contaminant ground-water plumes and DNAPL sources within plumes, evaluating the extent of DNAPL contamination, and initiating appropriate responses using a phased approach. The strategy places special emphasis on the use of early actions to prevent exposure, contain plumes and DNAPL sources, and prevent migration. In addition, the strategy encourages continued efforts to develop innovative technologies for addressing DNAPL contamination.

The Agency also issued guidance on October 4, 1993, providing a consistent process for invoking the TI waiver. The waiver is invoked primarily at contaminated ground-water sites, particularly sites that may be contaminated with DNAPLs. In situations where currently available technology will not achieve performance standards for remediation, the Agency may invoke the waiver, and further actions will be focused only on preventing migration of, and exposure to, the contaminants. Since issuing the TI waiver guidance, EPA has focused on broadening Regional,

state, and PRP awareness and understanding of the guidance and on developing an implementation strategy. Based on its analysis of the site-specific TI evaluations, the Agency drafted an implementation strategy that was near completion at the end of the fiscal year.

To further examine the various policy issues involved in addressing DNAPL contamination, the Agency conducted technical training seminars in all 10 Regions during FY94. Over 2,500 participants attended, including representatives from states, other federal agencies, and academia; private and public contractors; and PRPs.

4.4 REMEDY SELECTION

The Agency signed 99 RODs in FY94, including 39 new and amended RODs for PRP-financed and Fund-financed sites and 60 RODs for federal facility sites. The ROD documents the results of all studies performed on the site, identifies each remedial alternative that the Agency considered, and explains the basis for selecting the remedy. The ROD is signed after the RI/FS is completed and the public has had the opportunity to comment on the remedial alternatives that are being considered to clean up the site.

The Agency selected a variety of remedies in FY94 RODs, based on a careful analysis of characteristics unique to each site and the proximity of each site to people and sensitive environments (wetlands and endangered wildlife are examples of environmental resources that are taken into consideration when evaluating remedies). Congress, with the enactment of SARA, indicated that EPA should give preference to permanent remedies, such as treatment, rather than temporary remedies, such as containment.

A list of the 99 RODs signed during FY94 is provided in Appendix C. To fulfill the statutory requirement of CERCLA Section 301(h)(1)(A) to provide an abstract of each feasibility study (i.e.,

ROD), a summary of each ROD will be published separately in the *ROD Annual Report: Fiscal Year 1994*.

4.5 USE AND DEVELOPMENT OF TREATMENT TECHNOLOGIES

In SARA, Congress amended CERCLA to require that EPA favor the use of permanent remedies over containment or disposal in selecting remedies for Superfund sites. In each of the past six years, more than 70 percent of the RODs have contained provisions for the treatment of at least some waste.

To support the Agency's efforts to develop and improve treatment remedies, the Office of Research and Development (ORD) administers the Superfund Innovative Technology Evaluation (SITE) program for developing, demonstrating, and evaluating new treatment, monitoring, and measurement technologies and disseminating unbiased and validated information about them. Cooperatively, ORD and the Office of Solid Waste and Emergency Response (OSWER) have also established six technical support centers (TSCs) and the Superfund Technical Liaison (STL) program. A seventh TSC has been established with the Office of Air and Radiation (OAR). The purpose of the TSCs and STL program is to increase the speed and quality of Superfund cleanups and reduce clean-up costs by providing Superfund staff with direct technical support from the Agency's scientists and technical experts. ORD also supports information transfer activities, such as seminars, bulletins, and electronic information sources, and supplies technical assistance to the federal, state, and public sectors for evaluating potentially applicable treatment technologies.

Within OSWER, the Technology Innovation Office (TIO) is responsible for encouraging the use of innovative technologies under Superfund. TIO produces a variety of reports, journals, databases, and conferences to inform project managers, engineers, academics, contractors, and other interested

parties about the availability of new technologies and their potential applications. TIO works with other offices within the Agency to affect policy change, analyze trends in technology application, identify vendors and remediation markets, collect cost and remediation data, and champion innovative technologies. Outside EPA, TIO works with other federal agencies and the private sector in collaborative efforts to demonstrate technologies and coordinate research activities.

4.5.1 Superfund Innovative Technology Evaluation Program Progress

Historically, the use of innovative treatment technologies at contaminated sites has been impeded by a lack of reliable cost and performance data. To overcome this impediment and to respond to the increased demand for validated hazardous waste treatment technologies, SARA directs EPA, "to carry out a program of research, evaluation, testing, development, and demonstration of alternative or innovative treatment technologies...which may be utilized in response actions to achieve more permanent protection of human health and the environment"" (CERCLA Section 311(b)1, as amended by SARA Section 209(b)). The SITE program was established by ORD and OSWER to satisfy these statutory requirements and to support the Agency's efforts to develop and implement faster, more effective, and less costly treatment remedies.

The program, which completed its ninth year in FY94, is considered the pioneer and model program for demonstrating and evaluating full-scale, viable, innovative treatment technologies at hazardous waste sites. It serves as an integral part of the EPA's research into alternative methods for cleaning up the sites. It is also the first program to provide cost sharing opportunities for the private sector by awarding cooperative agreements (CAs) to technology developers and sharing the costs of evaluating participating technologies.

The SITE program supports all stages of technology development, from bench-scale and pilot tests to full-scale field demonstrations. EPA

documents and publishes engineering, performance, and cost data on the technologies tested as part of the program to assist the user community in making selections for site characterization and remediation, and assists developers in commercialization activities. From its inception in 1986 through FY94, 88 technologies have successfully been demonstrated through the SITE program. As of the end of FY94, there were 86 technology developers participating in the program.

As intended, the Agency's continuing efforts under the SITE program to compile and communicate data to the user community has increased the number of innovative technologies being employed. This upward trend exemplifies the program's effectiveness in implementing the Congressional mandate. EPA's analysis of technologies evaluated under the SITE program also indicates that innovative treatment technologies are more cost-effective than standard remedial treatments. For example, Exhibit 4.5-1 illustrates the cost savings identified in a limited study of 17 RODs under which remedial technologies in the SITE program were tested. The average cost savings for using innovative treatment technology versus standard treatment per site was \$21 million, representing a savings of 62 percent.

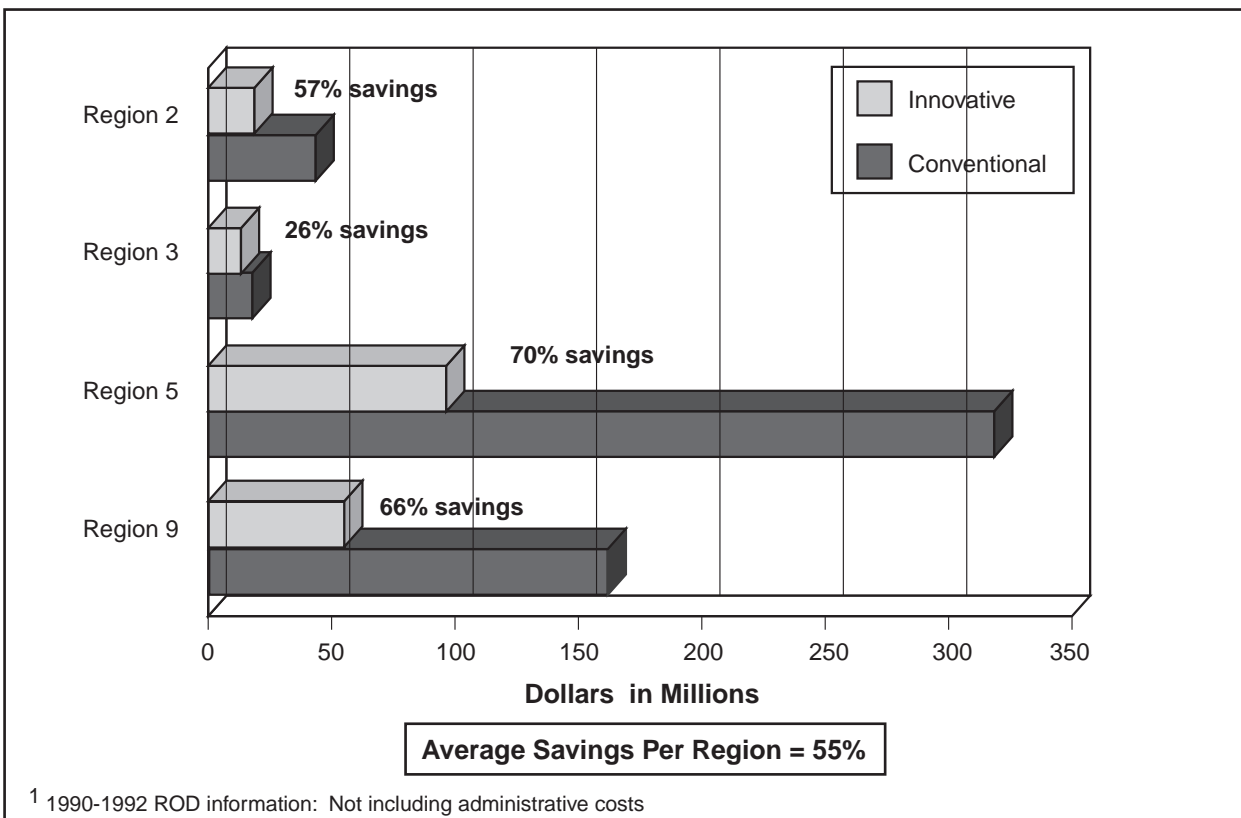
Successful implementation of innovative technologies requires a team approach. To ensure the timely introduction of new technologies into the marketplace, the SITE program maintains flexibility and maximizes the efficient use of available resources by working with other federal and state agencies, the private sector, EPA Regional offices, the Superfund Technical Assistance Response Team (START), OSWER, and technology developers. The Test and Evaluation Facility and the Center Hill Facility in Cincinnati, Ohio are also used to evaluate innovative technologies.

Operational Areas

The SITE program consists of the following four components:

- The Emerging Technology program;
- The Demonstration program;
- The Characterization and Monitoring program;

Exhibit 4.5-1
Cost Savings Associated with the Use of Innovative Technologies at 17 Sites¹



Source: Office of Research and Development.

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and

- **Technology Transfer.**

The Emerging Technology and Demonstration programs are administered by the Risk Reduction Engineering Laboratory in Cincinnati (RREL-Cin), Ohio. The Characterization and Monitoring program is administered by the Environmental Monitoring Systems Laboratory - Las Vegas (EMSL-LV), Nevada. Technology Transfer is an integral component of each of the SITE operational programs.

Emerging Technology Program: The SITE Emerging Technology program is EPA's first program to provide an opportunity to the private sector to share costs in technology development. Through CAs under the program, EPA provides technical and financial support to developers for researching, developing, and advancing promising

technologies from proof of concept, bench-, and pilot-scale to field demonstration and commercialization. Approximately 97 percent of the developers in the program are small businesses.

Under the Emerging Technology program, the applicability of particular technologies to Superfund site waste characteristics is evaluated, and technologies showing promise may be considered for more rigorous testing in the SITE Demonstration program. Each technology's performance is documented in a final report, project summary, and bulletin. Since the program's inception in 1987, the Agency has accepted 72 technologies into the program. Forty-two of the technology projects have been completed and 30 are ongoing. Exhibit 4.5-2 categorizes the completed and ongoing technology projects by treatment type. Technology development projects range from bench-, pilot-, and field-levels of

research, with over 20 of the 30 on-going technologies involved in field development.

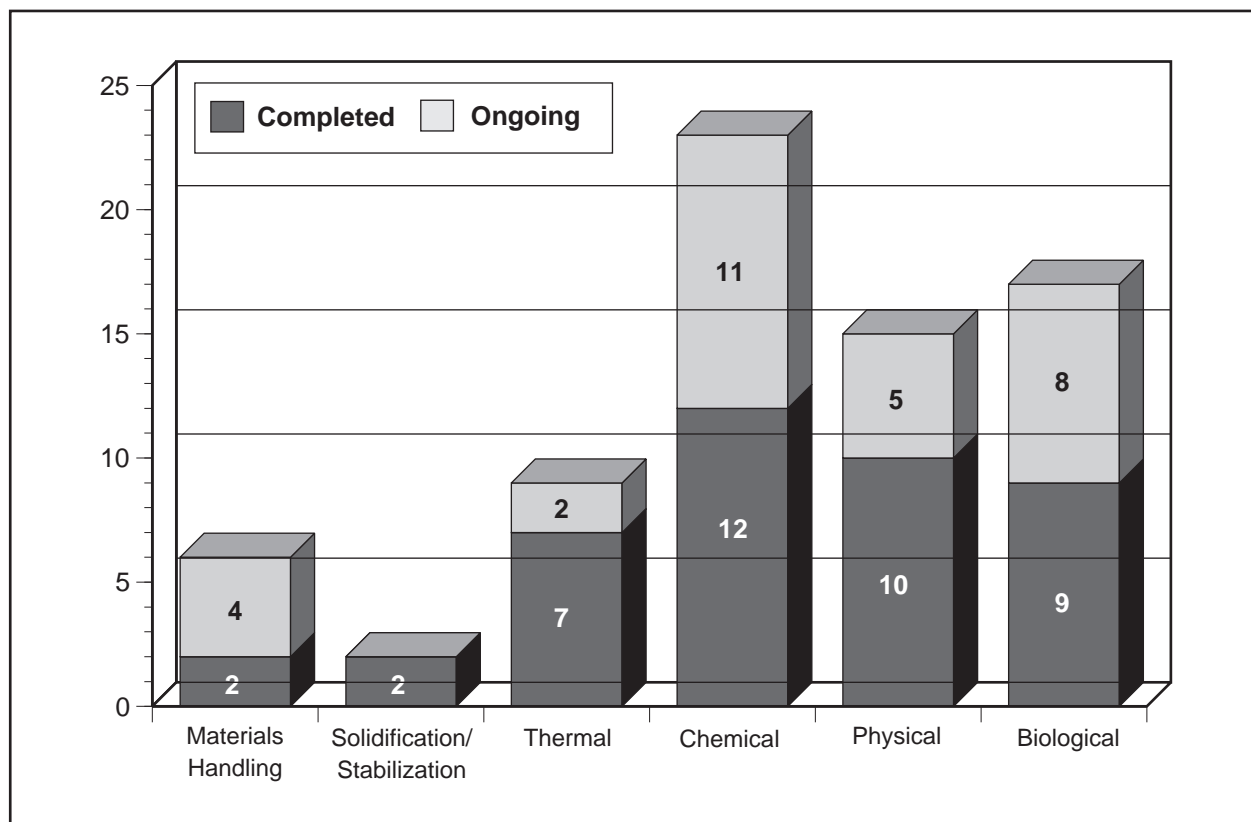
Technologies in the Emerging Technology program include eight technologies accepted in the program during FY94. Exhibit 4.5-3 describes these eight technologies. Exhibit 4.5-4 describes the nine projects that were completed under the program in FY94.

Demonstration Program: The SITE Demonstration program develops reliable engineering, performance, and cost data on innovative, alternative technologies so that potential users can evaluate a technology's applicability for a specific waste site. The goal of the SITE Demonstration program is to encourage the commercial use of promising innovative treatment technologies that are better, faster, and more cost-effective than available treatment technologies. Demonstrations are conducted on hazardous waste sites, including NPL and non-NPL sites, or under

simulated hazardous waste site conditions at developer or federal test and evaluation facilities. Data collected from SITE demonstrations and its analysis provide technology users with both quantitative and qualitative information on the technology's performance, potential need for pre- and post-processing, applicable waste and media types, potential operating problems, and approximate capital and operating costs. Technology evaluations also provide valuable insight into long-term O&M costs and risks.

Seventeen new technologies were accepted into the Demonstration program in FY94, including five from the SITE program's annual requests for proposals, eight from nominations by EPA's Regional offices and other government agencies, and four from the SITE Emerging Technology program. Exhibit 4.5-5 provides a summary of new technologies accepted into the SITE Demonstration program in

Exhibit 4.5-2
Emerging Technology Program Projects by Treatment Category



Source: Office of Research and Development.

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Exhibit 4.5-3
SITE Emerging Technology Projects Accepted Into Program In Fiscal Year 1994

Treatment Category: Chemical
<p><i>Institute of Gas Technology, Illinois</i>, developed a supercritical extraction/liquid phase oxidation process to remove and destroy contaminants in soil and sludge. The process uses supercritical fluid extraction and wet-air oxidation steps to treat chlorinated and nonchlorinated PAHs, PCBs, and other organic compounds. The process is suitable for both high and low concentrations of organic contaminants.</p> <p><i>Membran Corp., Minnesota</i>, developed a membrane apparatus to transfer gases into water without bubble formation and VOC emissions. The device will be tested in bioreactors that require the transfer of oxygen, methane, and hydrogen into the water phase to biodegrade petroleum hydrocarbons and chlorinated solvents. The device is also applicable to <i>in situ</i> ground-water treatment.</p> <p><i>M.L. Energia, New Jersey</i>, uses reductive thermal oxidation and reductive photo-thermal oxidation to convert chlorinated hydrocarbons into environmentally benign and useful materials such as hydrocarbons, hydrogen chloride, and carbon dioxide. The process is applicable to the treatment of air streams contaminated with chlorinated hydrocarbons.</p> <p><i>IT Corporation, Ohio</i>, developed a process that removes heavy metals from contaminated soil and sludge by forming a soluble chelate that can be separated, leaving clean soil. The technology is potentially applicable to the treatment of a wide variety of metal-contaminated hazardous wastes.</p> <p><i>University of Houston, Texas</i>, invented a concentrated aqueous salt solution to extract lead from contaminated soil. The technology is especially applicable to battery waste sites. The project will also evaluate uses of the technology to extract other heavy metals.</p>
Treatment Category: Biological
<p><i>ABB Environmental Services, Massachusetts</i>, created an <i>in situ</i> biological treatment for compounds such as tetrachloroethylene and trichlorethylene in saturated soils and aquifers. Advanced anaerobic/aerobic sequential biodegradation is a key element in the process.</p> <p><i>Geo-Microbial Technologies, Oklahoma</i>, uses anaerobic biotreatment to release toxic metals from contaminated soil. The process has advantages over aerobic biotreatment, which can produce waste streams containing sulfuric acid and soluble heavy metals. The process is applicable to the treatment of soil, sludge, and sediment contaminated with metals, hydrocarbons, and organic pollutants.</p>
Treatment Category: Materials Handling
<p><i>TMA Eberline (Thermo Analytic), New Mexico</i>, developed a material handling process to automatically separate radioactive material from otherwise clean soil. The process may dramatically reduce the overall amount of material requiring disposal by minimizing the amount of clean soil that is co-mingled with radioactive material.</p>

Exhibit 4.5-4
Projects Completed Under the SITE Emerging Technology Program
in Fiscal Year 1994

Treatment Category: Chemical
<p><i>Cognis, California</i>, developed the TERRAMET[®] soil remediation system, that leaches and recovers lead and other metals from soil, dust, sludge, or sediment. An aqueous leachant is used to remove most types of lead contamination: metallic lead, soluble ions, and insoluble lead oxides and salts. The project has achieved greater than 98 percent lead removal. Based on initial results, this project was also accepted into and evaluated in the SITE Demonstration program.</p> <p><i>ART International, New Jersey</i>, created a special combination of organic solvents in an innovative chemical process to extract organic pollutants from soil, sediment, and sludge. The technology, known as the LEEP[®] process has application for a wide range of contaminants including tar, chlorinated hydrocarbons, PAHs, PCBs, pesticides, and wood-preserving compounds. A pilot plant has been constructed and commercialization activities for a full-scale unit are underway.</p> <p><i>Matrix Photocatalytic, Canada</i>, developed a process to destroy organic contaminants in air using a titanium dioxide photocatalytic reactor. The system can treat a wide range of chlorinated and nonchlorinated VOCs, including more resistant compounds such as carbon tetrachloride. The project has been invited into the SITE Demonstration Program where both air and water waste streams will be evaluated.</p>
Treatment Category: Physical
<p><i>Pulse Sciences Inc., California</i>, uses high-energy x-rays to destroy organic contaminants, leaving only nontoxic by-products. The technology treats groundwater and wastewater contaminated with chlorinated and nonchlorinated organic compounds, and substances that can deplete the ozone layer, such as freon.</p>
Treatment Category: Biological
<p><i>New Jersey Institute of Technology, New Jersey</i>, integrated two innovative techniques—pneumatic fracturing of soil and bioremediation—to enhance <i>in situ</i> remediation of soil contaminated with petroleum hydrocarbons and BTEX compounds. The project was successful and a full-scale demonstration is anticipated. A two-year field development effort was completed at a British Petroleum site in Maryland.</p>
Treatment Category: Materials Handling
<p><i>Montana College of Mineral Science, Montana</i>, uses a specially designed hydrocyclone to treat mining wastes containing heavy metals. The wastes are a source of ground- or surface-water contamination. The process is especially applicable to heavy metal sulfides. Currently, investigators are in search of waste sites to demonstrate this technology.</p> <p><i>EA Technology, United Kingdom</i>, developed a comprehensive soil-separation and washing process to remove metals, petroleum hydrocarbons, and polynuclear aromatic hydrocarbons. This process may also be applicable to sediment and sludge. This technology can provide stand-alone treatment or be incorporated in a treatment train.</p>

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Exhibit 4.5-4
Projects Completed Under the SITE Emerging Technology Program
in Fiscal Year 1994, cont.

Treatment Category: Thermal
<p><i>University of Dayton, Ohio</i>, created an air-treatment process using photothermal reactions conducted at moderate temperatures (200–500°F) to destroy a wide range of organic compounds including PCBs and chlorinated solvents. The process offers much higher throughput than other photo-oxidation processes. In addition, no dioxin or furan was formed, which can be problematic by-product of conventional thermal oxidation processes. A full-scale demonstration is anticipated.</p>
Treatment Category: Solidification/Stabilization
<p><i>Western Product Recovery, Texas</i>, invented a chemical bonding and adsorption process to convert heavy metals in soil, sediment and sludge to non-leaching ceramic silicate pellets that can either be left on site or used as an aggregate for concrete or other applications. The process can also oxidize organics in the waste stream; the resulting ceramic pellets will be organic free. Efforts are underway to design a transportable production unit.</p>

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FY94. As of the end of FY94, the SITE Demonstration program included 117 accepted, ongoing, and completed technologies. Thirteen of the technologies were evaluated in the field in FY94 and are described in Exhibit 4.5-6.

Characterization and Monitoring Program: The goal of the Characterization and Monitoring program is to validate the performance of innovative and alternative monitoring, measurement, and site characterization technologies. This validation accelerates the recognition of technologies that have the potential to provide cost-effective, high quality, faster, or safer means of detecting, quantifying, and monitoring contaminants at Superfund sites.

Through FY94, the program has involved more than 32 different characterization and monitoring technologies. During FY94, the program received peer review comments from the FY93 demonstration of PCB screening technologies and incorporated these changes into a revised report format. Also during the fiscal year, nine technologies were demonstrated for pentachlorophenol (PCP) and cone-penetrator-deployed sensors. The PCP demonstration involved five technologies, including four immunoassay test kits and a field analytical

screening technology, that were demonstrated in conjunction with a remediation technology, base catalyzed decomposition process. Cone-penetrator-deployed sensors demonstrated included resistivity, pH, seismology, and temperature; soil, water, and vapor sampling; and two laser fluorescence screenings for polyaromatic hydrocarbons (PAHs) and BTEX. In addition, EMSL-LV initiated plans for demonstrating and evaluating a field portable x-ray fluorescence spectrometer.

Technology Transfer Program: Technical information from the three innovative technology programs described above is disseminated through various activities to increase awareness and promote the commercial use of innovative technologies for assessment and remediation of Superfund sites. These activities include publishing and distributing SITE program documents such as project-specific fact sheets, bulletins, capsules, application reports, peer review journal articles, and technical data packages; conducting community outreach activities such as presentations at conferences, program-specific brochures, on-site visitor's days, demonstration videotapes, and exhibits; participating in forums, interagency task forces, and associations; and

Exhibit 4.5-5 New Technologies Accepted Into the SITE Demonstration Program In Fiscal Year 1994

Treatment Category: Physical/Chemical

SIVE Services, California, created an enhanced steam-injection and vacuum extraction method designed for *in situ* treatment of contaminated soil at relatively shallow depths.

Lockheed Missiles and Space Co., California, created a batch electrokinetic remediation (BEKR) process that uses ceramic electrodes to move contaminants through soil. Water is circulated through the electrode casings to collect and remove contaminants. The BEKR process is designed to remove both toxic anions and cations from soil, mud, and sludge. Regeneration of the system produces a concentrated contaminant brine that can be treated further or disposed.

Morrison Knudsen, Corp., Idaho, created a clay-based grouting technology that integrates three primary phases: obtaining detailed information about site characteristics, developing a site-specific grout formulation, and placing the grout. The technology, developed by a Ukrainian firm, is being evaluated at an abandoned mine in Montana.

Process Technologies, Inc., Idaho, developed a photolytic destruction process that photolyses vapor-phase halogens. Key features of the technology include that there are no moving parts, and its modular design allows for easy scale-up. A demonstration of the technology was initiated in late September, 1994 at McClellan Air Force Base in Sacramento, California, to treat off-gases from an existing soil-vapor extraction system.

Electro-kinetics, Louisiana, developed the Electro-Klean electrokinetics soil process that separates and extracts heavy metals and organic contaminants from soil. This technology may be applied *in situ* or *ex situ*, and uses direct currents with electrodes placed on each side of the contaminated mass. Several studies of this technology have been previously conducted under the Emerging Technology Program. Sandia National Laboratories, New Mexico, created the Electrokinetic remediation technology, an *in situ* process designed to treat cadmium in arid soil. A demonstration of the technology is planned for mid-1995 in Albuquerque, New Mexico.

Xerox, Corp., New York, developed a two-phase extraction process that uses a high-vacuum source applied to an extraction tube within a water well to increase ground-water removal rates and to volatilize and extract that portion of contaminant from the sorbed or free-product phases. A demonstration of this process began in August 1994 at the McClellan Air Force Base in Sacramento, California.

EET, Inc., Texas, created the TECHXTRACT™ process, employing proprietary chemical formulations in successive steps to remove PCBs, toxic hydrocarbons, heavy metals, and radionuclides from the subsurface of porous materials such as concrete, wood, brick, and steel.

RKK, Ltd., Tennessee, developed CRYOCELL®, a frozen soil barrier that completely contains waste, preventing migration to the soil, or isolates a contaminated area during an *in situ* remediation program. Preliminary tests of the technology have been conducted at the DOE Oak Ridge National Laboratory. The demonstration is planned for the DOE Hanford facility in Richland, Washington.

Exhibit 4.5-5
New Technologies Accepted Into the SITE Demonstration Program
in Fiscal Year 1994, cont.

Treatment Category: Physical/Chemical, cont.
<p><i>BioGenesis Enterprises, Inc., Virginia</i>, developed the BiogenesisSM process that uses specialized equipment, surfactants, and water to clean soil and sediment contaminated with PCBs. The PCB sediment washing system will be tested in early 1995 at the Alameda Naval Station in Alameda, California. Another version of the BiogenesisSM system was successfully tested on hydrocarbons under the SITE program in 1992.</p> <p><i>Matrix Photo-catalytic, Ltd., Canada</i>, developed a photocatalytic oxidation system that removes and destroys dissolved organic contaminants from water in a continuous flow process at ambient temperatures. The system also treats chlorinated compounds such as PCBs. A demonstration of the technology is planned at the DOE Oak Ridge National Laboratory.</p> <p><i>Matrix Photo-catalytic, Ltd., Canada</i>, created a photocatalytic oxidation system that removes and destroys organic contaminants from air.</p> <p><i>TriWaste Reduction Services, Inc., Canada</i>, developed the TriWaste Reduction system that combines a thermal phase separation system with a soil-washing treatment system. The system is designed to treat metals and chlorinated organic compounds.</p>
Treatment Category: Biological
<p><i>Pintail Systems, Inc., Colorado</i>, created a technology that uses microbial detoxification of cyanide in heap leach processes to reduce cyanide levels in spent ore and process solutions. Two full-scale cyanide detoxification projects have been completed, and a demonstration is planned for the Summitville Mine Superfund site in Colorado.</p> <p><i>SBP and Environmental Laboratories, Inc., Connecticut</i>, created the vacuum-vaporized well system consisting of a specially adapted ground-water well, a negative-pressure stripping reactor, an <i>in situ</i> bioreactor, and an above-ground vapor-phase bioreactor. The technology is a part of the demonstration jointly sponsored with the New York State Department of Environmental Conservation (NYDEC) and the New York State Center for Hazardous Waste Management.</p> <p><i>R.E Wright Associates, Inc., Pennsylvania</i>, developed a process using a bioventing technology in which injection and extraction wells enable the developer to regulate oxygen and nutrient levels to stimulate the native bacteria in the soil to biodegrading the contaminants of concern. The technology is a part of the demonstration jointly sponsored with the NYDEC and the New York State Center for Hazardous Waste Management.</p> <p><i>ENSR Consulting & Engineering and Larson Engineering, Texas</i>, developed a process that treats VOC-soils in biovaults. Nutrients, moisture, and oxygen levels can be controlled within the constructed vaults. The technology is a part of the demonstration jointly sponsored with NYDEC and the New York State Center for Hazardous Waste Management.</p>
Treatment Category: Thermal
<p><i>Vortec, Corp., Pennsylvania</i>, developed a system that oxidizes and vitrifies soil, sediment, sludge, and mill tailings that have organic, inorganic, and heavy-metal contamination. The technology was previously tested under the Emerging Technology Program. Transportable systems are being developed for soil remediation at DOE facilities.</p>

Exhibit 4.5-6 SITE Demonstration Projects Completed in Fiscal Year 1994

Treatment Category: Physical/Chemical, cont.

Cognis, Inc., California, demonstrated the Cognis TERRAMET® soil-remediation system for leaching and recovering lead and other metals from contaminated soil, dust, sludge, or sediment. Appropriate sites include contaminated ammunition testing areas, firing ranges, battery-recycling centers, scrap yards, metal-plating shops, and chemical manufacturers. The technology was demonstrated at the Twin Cities Army Ammunition Plant in New Brighton, Minnesota.

North American Technology/Aprotek, California, demonstrated a hydrocarbon-recovery technology that uses an oleophilic amine-coated ceramic chip to separate suspended and dissolved hydrocarbons, and some chemical emulsions from aqueous solutions. The technology is effective on gasoline, crude oil, diesel fuel, benzene, toluene, ethylbenzene, xylene compounds, as well as PAHs, and a variety of chlorinated hydrocarbons. This technology was demonstrated in Fort Lauderdale, Florida.

ROCHEM, California, demonstrated the ROCHEM Disc Tube Module System™ that uses membrane separation to treat aqueous solutions ranging from waste water to leachate contaminated with organic solvents. Many types of waste material can be treated with this system, including sanitary and hazardous landfill leachate containing both organic and inorganic contaminants. The Disc Tube Module System was demonstrated in Johnston, Rhode Island.

Roy F. Weston, California, demonstrated the Unterdruck-Verdampfer Brunnen (UVB) vacuum-vaporizing well, an in-situ system for remediating contaminated aquifers, especially those contaminated with VOCs. Depending on the circumstances, the UVB system may also remediate semivolatile organic compounds (SVOCs) and heavy metals. The demonstration was conducted at March Air Force Base in Ontario, California.

Billings & Associates, Inc., New Mexico, demonstrated the subsurface volatilization and ventilation system (SVVS®) technology that uses a network of injection and extraction wells to treat subsurface organic contamination using soil vacuum extraction in combination with in-situ biodegradation. The system applies to sites with leaks or spills of gasoline, diesel fuels, and other hydrocarbons, including halogenated compounds. The SVVS® was demonstrated in Buchanan, Michigan.

Terra Kleen Response Group, Inc., Oklahoma, demonstrated a solvent extraction treatment system, a waste minimization process designed to remove SVOCs, VOCs, and chlorinated compounds from soils. The system was demonstrated in San Diego, California.

Dynaphore Inc., Virginia, created the Dynaphore FORAGER® Sponge; an open-celled cellulose sponge with an amine-containing polymer that has a selective affinity for aqueous heavy metals in both cationic and anionic states. The sponge can scavenge metals in concentration levels of parts per million and parts per billion from industrial discharges, municipal sewage, process streams, and acid mine-drainage waters. The sponge was demonstrated in Pedricktown, New Jersey.

Exhibit 4.5-6

SITE Demonstration Projects Completed in Fiscal Year 1994, cont.

Treatment Category: Biological
<p><i>J.R. Simplot, Idaho</i>, demonstrated the Simplot anaerobic biological remediation (SABRE™) process designed to treat soils contaminated with nitroaromatic pollutants. The technology was demonstrated on trinitrotoluene at the Weldon Springs Ordnance Works, an abandoned manufacturing site in Weldon Springs, Michigan.</p> <p><i>Grace Dearborn, Inc, Canada</i>, demonstrated the organic amendment-enhanced bioremediation technology (DARAMEND™), designed to degrade organic contaminants, including PCP, PAHs, and petroleum hydrocarbons in industrial soil and sediment. The technology treats batches of soil by incorporating DARAMEND™ amendments into the soil using conventional agricultural methods. The technology was demonstrated in Ontario, Canada.</p>
Treatment Category: Thermal
<p><i>KAI Technology, Massachusetts</i>, demonstrated a radio frequency heating (RFH) <i>in situ</i> process, that uses electromagnetic energy to heat soil and improve soil vapor extraction. The RFH technique has been tested in removing petroleum hydrocarbons, VOCs and SVOCs from soil. It was demonstrated at Kelly Air Force Base as part of a joint project with the U.S. Air Force Armstrong Laboratory in San Antonio, Texas.</p> <p><i>Maxymillian Technology, Inc., Massachusetts</i>, demonstrated a portable thermal-desorption system (TDS) that uses rotary kiln technology to remove contaminants from soil. The TDS is designed to remediate soil contaminated with VOCs, SVOCs, and PAHs, and was demonstrated in Utica, New York.</p> <p><i>Texaco Syngas, Inc., New York</i>, demonstrated an entrained-bed gasification process, a noncatalytic, partial oxidation process in which carbonaceous substances react at elevated temperatures and pressures, producing a gas containing primarily carbon monoxide and hydrogen. This gas can be used to produce other chemicals or burned as fuel. The system can treat soil, sludge and sediment contaminated with both organic and inorganic constituents, chemical wastes, and petroleum residues. The process was demonstrated in Fresno, California.</p> <p><i>Geosafe, Corporation, Washington</i>, demonstrated an <i>in situ</i> vitrification system that uses electric currents to melt soil or other earthen materials at high temperatures, destroying organic pollutants by pyrolysis. Inorganics are incorporated within the vitrified glass and crystalline mass. This technology was demonstrated in Grand Ledge, Michigan.</p>

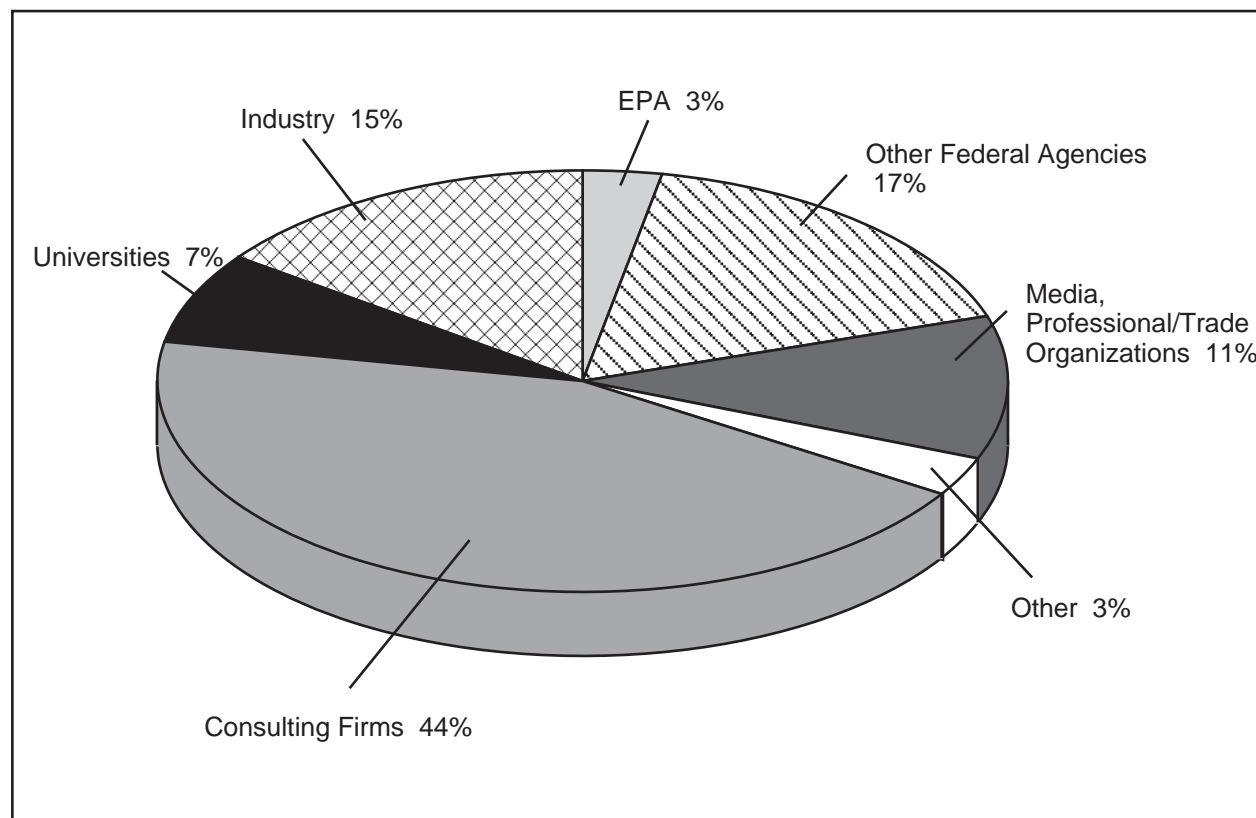
providing technical assistance to Regions, states, and remediation clean-up contractors. Nearly 323,000 SITE program publications were distributed to requesters in FY94, including approximately 1,000 technical evaluation reports, 78,000 summaries, 109,000 application reports, 16,500 profiles, and 119,000 bulletins. As illustrated in Exhibit 4.5-7, the highest percentage of requests (44 percent) came from engineering consulting firms.

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4.5.2 Superfund Technical Assistance Programs

Superfund projects require broad technical knowledge and expertise. To provide multi-disciplinary expertise and technical support for Superfund cleanups, the Agency sponsors TSCs,

Exhibit 4.5-7
Requests for SITE Documents



Source: Office of Research and Development.

51-044-28

START, the ORD STL program, and the Ground-Water and Engineering Forums. The goals of these technical assistance programs are to increase the speed and quality of Superfund cleanups, reduce clean-up costs, address technical issues encountered in site cleanup, and provide Regional Superfund staff with direct access to the technical expertise and resources of the Agency's researchers.

Technical Support Centers and Superfund Technical Assistance Response Team

In FY94, the Agency funded seven TSCs: five ORD laboratories, the OERR Environmental Response Team (ERT), and one OAR laboratory. ORD also sponsored the START program. The purpose of the TSCs and the START program, described in detail below, is to provide site-specific

technical assistance in the areas of release response, site characterization, human health risk assessment, ecological assessment, radiological evaluation, ground-water remediation, and engineering. The TSCs and START program responded to approximately 430 technical support requests at more than 400 Superfund sites in FY94. The TSCs and START program are invaluable to the Agency's Superfund effort, fulfilling a critical niche in developing and delivering the best expertise available in support of faster, better, and more cost-effective cleanups.

Monitoring and Site Characterization TSC: ORD-Environmental Monitoring Systems Laboratory-Las Vegas, Nevada : The EMSL-LV TSC provides scientific and technical assistance for contaminant detection, sampling/monitoring design, hydrological

monitoring, site characterization, data interpretation, and geophysics. The EMSL-LV TSC delivers a range of services for application at Superfund sites, including saturated and unsaturated zone modeling; remote sensing, mapping, and geostatistics; analytical methods and quality assurance; bore-hole and surface geophysics; x-ray fluorescence field survey methods; sampling and monitoring design assistance; mixed waste assistance; and radiological analysis.

In FY94, the EMSL-LV TSC provided technical assistance for 44 Superfund sites, typically providing multiple support activities at individual sites. In addition, the EMSL-LV TSC responded to 123 short-term requests for technical support (i.e., requests that can be completed within a 40-hour period) and 12 requests for remote sensing support. EMSL-LV TSC scientists also wrote an issue paper titled *Identifying Background Levels of Naturally Occurring Inorganics and Man-Made Substances in Soils and Sediments*. In response to a request to EPA's Office of International Activities (OIA) received through the U.S.-Asia Environmental Partnership program, the EMSL-LV TSC assisted the Republic of Palau in identifying methods to determine whether hazardous leachate from a landfill was migrating into, and damaging, the surrounding sensitive environment.

Health Risk Assessment and Toxicology TSC: ORD-Environmental Health and Criteria Office-Cincinnati, Ohio: The Environmental Health and Criteria Office-Cincinnati (ECAO-Cin) TSC functions as a focal point to coordinate Agency-wide assistance in the area of human health risk assessment. Coordinating with OERR's Toxics Integration Branch, ECAO-Cin identifies future research issues and ensures consistent dissemination and use of risk assessment toxicity values and other guidance. Technical services available from the ECAO-Cin TSC include chemical-specific and chemical-mixture toxicity information; support for the Health Effects Assessment Summary Tables (HEAST); support for the *Risk Assessment Guidance for Superfund-Human Health Evaluation Manual*; technical review and comment on site-specific Superfund risk assessments; and coordination of information for the risk assessment teleconference for Superfund.

In FY94, the ECAO-Cin TSC responded to approximately 2,500 requests for individual chemical toxicity values. In addition, the ECAO-Cin TSC updated 25 risk assessment issue papers, reviewed and revised 22 subchronic assessments for the annual update of HEAST, and processed 360 support questions from HEAST users.

Ecological Assessment TSC: ORD-Environmental Monitoring Systems Laboratory-Cincinnati, Ohio: The Environmental Monitoring Systems Laboratory-Cincinnati (EMSL-Cin) TSC develops indicators of ecological conditions and provides technical assistance in aquatic and terrestrial ecological assessment, including technical reviews, biological collection and assessment of aquatic and terrestrial systems, physical habitat assessment, and ecotoxicity assessments. Ecotoxicity assessments include toxicity testing of water, sediment, and soil with vertebrates, invertebrates, and plants. The EMSL-Cin TSC conducted 130 water-column and 48 toxicity tests at nine hazardous waste sites in FY94. Bioassessments using fish, macroinvertebrates, and periphyton were also conducted at three of these sites.

In addition to providing direct technical support, the EMSL-Cin TSC conducts important ecological research into how contaminants from hazardous waste sites affect ecological resources. For example, EMSL-Cin ecologists have constructed 12 artificial streams to function as mesocosms that can be used to study the impacts of mine wastes on water plants and fish communities. Using these artificial streams, EMSL ecologists have begun evaluating the impact on aquatic ecology of zinc, a major metal of concern in hard rock mining.

Ground-Water Characterization and Remediation TSC: ORD-R.S. Kerr Environmental Research Laboratory-Ada, Oklahoma: The R.S. Kerr Environmental Research Laboratory (RSKERL) is EPA's center for fate-and-transport research; it focuses its efforts on contaminants in the vadose and saturated zones of the subsurface, methodologies relevant to protection and restoration of ground-water quality, and evaluation of subsurface processes for the treatment of hazardous waste. The RSKERL

TSC provides technical assistance in the areas of pump-and-treat aquifer remediation, bioremediation of soil and ground water, subsurface geochemistry, contaminant transport modeling, subsurface contamination transformation, and *in situ* treatment processes.

The RSKERL TSC completed its seventh year of service in FY94. In addition to its numerous technology-transfer activities, the TSC has 666 active or completed site-specific projects at more than 320 Superfund sites. In FY94, the RSKERL TSC responded to 112 requests for assistance and added 64 new sites to its roster, including 7 federal facilities.

The RSKERL TSC also operates the Center for Subsurface Modeling Support (CSMoS) and the Subsurface Remediation Information Clearinghouse (SRIC). CSMoS provides direct technical support to EPA and state decision-makers in subsurface model applications. In addition, CSMoS manages, distributes, and supports the ground-water and vadose zone models and databases researched and developed at RSKERL. CSMoS has distributed more than 3,474 models in response to 1,717 requests, 65 percent of which were from private institutions such as consulting firms. SRIC provides a forum for rapidly developing, highly specialized scientific information. Activities include developing, collecting, evaluating, coordinating, and disseminating information related to the fate and transport of contaminants in soil and ground water. In FY94, SRIC distributed more than 6,932 publications in response to 2,554 requests. In addition, 11 technology transfer activities were provided for EPA Regions, states, other federal agencies, and the private sector. These activities focused on ground-water monitoring, modeling, and investigations; mechanical integrity of injection wells; ground-water sampling methods; and bioremediation.

Engineering and Treatment TSC: ORD-Risk Reduction Engineering Laboratory-Cincinnati, Ohio: The RREL-Cin TSC plans and conducts engineering, research, and development related to treatment of solid and hazardous wastes. RREL-Cin TSC staff provide technical services involving specific treatment technologies and Superfund response processes, including treatability studies, RD/remedy

selection review, construction quality-assurance/quality-control methods, and source control and geotechnical test methods.

The RREL-Cin TSC responded to over 80 requests for engineering assistance in FY94, including assistance in 26 treatability studies, 3 treatment screening option reviews, 13 technology evaluations, 6 RI/FS engineering reviews, and 27 requests for RD/RA engineering assistance. The RREL-Cin TSC also published an engineering issue paper on *in situ* treatment of unsaturated soil.

Environmental Response TSC: OERR-Environmental Response Team, Edison, New Jersey: The ERT TSC provides support for responses to releases of hazardous waste, chemicals, and oil. ERT also provides support in risk assessment, multimedia sampling and analysis, health and safety, clean-up techniques, and training for response personnel. Services include response techniques for emergency hazardous chemical releases; treatment technologies, sampling plans, and contaminant assessment; technical review of remedial and removal technologies, safety, and preparedness; the Hazardous Material Incident Response Training program; and site-safety plans, personnel protection, and safety. During FY94, ERT conducted 103 removal actions and 79 RAs, responded to 10 oil spills and 2 international incidents, and conducted 203 training courses nationwide.

Radiological and Chemical Assessment TSC: OAR-National Air and Radiation Environmental Laboratory, Montgomery, Alabama: The National Air and Radiation Environmental Laboratory (NAREL) TSC can assess, characterize, and remediate radiologically and chemically contaminated sites. In addition, the laboratory offers an expanding capability for analyzing heavy-metal and organic-waste contaminants. Specific NAREL TSC services include conducting and monitoring radiological assessment of sites; designing, evaluating, and demonstrating remediation technologies; analyzing samples for radionuclides; calculating and assessing dose and risk; evaluating, calibrating, and providing quality assurance for radon field measurements and instruments; and providing a nuclear emergency response team.

Superfund Technical Assistance Response Team: ORD-Risk Reduction Engineering Laboratory-Cincinnati, Ohio: In addition to the Engineering and Treatment TSC, RREL sponsors the START program. The START program provides intensive, long-term, site-specific technical and engineering support to provide better, faster, and more cost-effective remediation at Superfund sites with difficult engineering problems or sites of national significance. Sites admitted into the START program are nominated by EPA's Regional offices. In FY94, the START program provided assistance for 60 Superfund sites through more than 300 separate technical support activities. The START program also supported 50 treatability studies through design review and implementation and oversight of laboratory and field studies. In addition, the START program published four engineering bulletins on specific technologies, as well as two technical-resource documents on site types, such as pesticide- and solvent-contaminated sites, to help Regional staff evaluate and select the most appropriate remediation technologies.

Superfund Technical Liaison Program

Under the STL program, senior ORD scientists are permanently stationed in Regional offices. Through these ORD scientists, the STL program provides direct technical assistance to Regional staff, facilitates interaction among ORD laboratories and Headquarters' offices, promotes the application of good science within the Regional waste programs, and provides feedback to ORD on Regional technical needs.

Ground-Water and Engineering Forums

The Ground-Water and Engineering Forums, chaired by TIO, helped coordinate activities between Regional technical staff and the ORD laboratories for addressing ground-water and engineering concerns encountered in site remediation. In conjunction with the TSCs, the Ground-Water and Engineering Forums published issue papers on the remediation of PCBs, remediation of DNAPLs, use of pump-and-treat

technologies, and use of *in situ* soil treatment. The forums also provided opportunities for members to conduct technical reviews of four guidance documents during the year. In addition, seven forum members joined the American Society of Testing and Materials to help review standards that relate to EPA's field protocols.

To expand interagency coordination, the forums held joint semi-annual meetings with DOE and the United States Geological Survey. The meetings improve technology transfer and aid in interagency communication and coordination.

4.5.3 Technology Transfer and Interagency Sharing

TIO, as a producer of technological information, is widely recognized as a leader in the technology innovation arena. For more than five years, TIO has identified, cataloged, and disseminated information to users on many issues, including

- Trends in the use of innovative technology at Superfund, Resource Conservation and Recovery Act (RCRA), and underground storage tank (UST) sites;
- Future markets for innovative remediation technologies;
- Procurement barriers to the use of innovative technologies;
- Support services for technology developers;
- Screening matrices for technologies; and
- Demonstrations of technologies by other federal agencies.

TIO has also brought federal agencies, academics, and the private sector together to demonstrate and evaluate technologies. The following sections detail FY94 technology transfer and interagency information sharing efforts, including forums and conferences, demonstrations and evaluations of innovative technologies, reference materials, and training and continuing education opportunities.

Innovative Technology Forums and Conferences

To encourage collaborative efforts across EPA, other federal agencies, academics, and the private sector, EPA sponsored forums and conferences for exchanging information on innovative technologies. The Agency also participated in international information exchanges.

- *Fifth Forum on Innovative Hazardous Waste Treatment Technologies: Domestic and International:* TIO and ORD sponsored this conference to increase awareness of technologies that are ready for application to clean up sites. This three-day conference introduced and highlighted innovative treatment technologies that produced significant performance results. The conference showcased results of selected international technologies, the SITE program technologies, and case studies from the SITE program.
- *Federal Remediation Technology Roundtable:* Through this forum, TIO provided an information exchange network for federal agencies that were conducting applied research and developing innovative remediation techniques. The roundtable published the annual updates of three documents that describe federal technology demonstrations, databases, and publications about innovative technologies. Interagency communication through the roundtable also led to several joint initiatives to demonstrate technologies and create a uniform format for documenting cost and performance information.
- *Remedial Technologies Development Forum (RTDF):* The RTDF, organized by TIO and ORD, encourages collaboration among companies, public interest groups, states, universities, DOE, and DOD in defining, prioritizing, and funding clean-up technologies. By consulting on technologies at the earliest stages of their development, the RTDF seeks to combine the financial and intellectual resources of consortium members to promote research coordination and eliminate duplicative research and development. The RTDF formed four workgroups to look at specific research areas: *in situ* remediation technologies, bioremediation of chlorinated solvents, site characterization, and *in situ* soil flushing. The *in situ* remediation group initiated field work in the "Lasagna" process at DOE's Paducah facility in 1994 and will continue to develop the process. The "Lasagna" process is a treatment train that integrates hydrofracturing, electro-osmosis, and *in situ* treatment of VOCs in soils containing clay. The bioremediation group is planning six research projects on intrinsic bioremediation, anaerobic bioremediation, and co-metabolic bioventing. The other two groups are working to establish protocols for testing that will lead to field demonstrations of technologies for site characterization and *in situ* flushing. The RTDF is exploring the possibility of establishing two additional focus areas: permeable treatment walls and *in situ* treatment of metal-contaminated soils.
- *Marketplace Conferences:* TIO conducted two marketplace conferences during FY94, one in the Northeast and the other in the Rocky Mountain region. The purpose of these conferences was to highlight business opportunities and markets for vendors and developers of innovative treatment technologies. The conferences brought together top-level state, EPA, DOD, DOE, and Department of Commerce officials with business executives from technology firms. TIO plans to conduct at least two additional conferences, one on the west coast and another in the Southeast.
- *Efforts to Encourage Small Businesses:* To encourage small-business innovative technology vendors and users, EPA and the Small Business Administration (SBA) signed a memorandum of understanding (MOU). Through the MOU, SBA and EPA will engage in efforts to encourage small businesses to develop, market, and/or adopt cost-effective environmental technologies, helping facilitate both economic growth and environmental compliance. In efforts to identify mechanisms to improve access to capital for

small businesses, OSWER and SBA financed a study of small business developers and users of technology. Also under the MOU, SBA initiated a study of the environmental assistance capability of its Small Business Development Center network. This study assessed the national network's potential to deliver environmental compliance, pollution prevention, and environmental development assistance for the small business community and provided a plan to implement such a program.

- **International Efforts:** To encourage international exchange of information on clean-up technologies, representatives of OSWER and ORD served as project directors of a pilot study for the North Atlantic Treaty Organization's Committee for the Challenges to Modern Society. This study, a follow-up to a successful effort to share information on innovative treatment technologies, evaluated both demonstrated and emerging remedial technologies for the cleanup of contaminated land and ground water. In the first phase of the study, participants discussed and exchanged information on 29 soil and ground-water remediation projects. The second phase continues work on field-demonstrated technologies, and also expands the scope to include emerging processes in earlier stages of development. Eighteen countries actively participated in this program and, at the end of FY94, 46 case study projects were underway.

Efforts to Demonstrate and Evaluate Innovative Treatment Technologies

To encourage increased use of innovative treatment technologies, TIO improved the documentation of cost and performance data for innovative treatment technologies. TIO also engaged in projects such as the public-private partnership program to demonstrate new technologies.

To measure performance or "benchmark" innovative technologies, TIO continued gathering data on 17 completed Superfund RAs that used innovative technologies for full-scale remedies. Coordinated through the Federal Remediation Technologies Roundtable, the project also aims to

standardize cost and performance reporting by other federal agencies engaged in similar efforts.

In the public-private partnership program, TIO, the Air Force, Clean Sites, and potential users of innovative treatment technology collaborate to evaluate the cost-effectiveness of remediation technologies. The partnership project is based on the premise that risk-sharing is a critical incentive to encourage increased use of new technologies. Commercialization of new technologies is often hampered by the hesitation of PRPs to risk the cost of, and potential liability arising from, a failed test of a proposed technology at their site. The public-private partnership project evaluates technology applications, particularly for *in situ* processes, at federal facilities with contamination problems that are similar to those faced by the participating corporations at their own facilities. Using federal facilities as test locations is one of the government's major contributions to promoting new environmental technologies. This mutually beneficial arrangement reassures industry about the commercial use of the technology and helps to defray the government's evaluation costs. A partnership project for joint testing and evaluation of technologies at McClellan Air Force Base started in late FY94. At McClellan, the partnership is evaluating two-phase extraction and photolytic destruction.

Reference Materials

To encourage use of innovative technologies, the Agency provides and maintains a variety of reference materials on the technologies. Examples include three electronic sources of information on innovative treatment technologies: the Alternative Treatment Technology Information Center (ATTIC), the Vendor Information System for Innovative Treatment Technologies (VISITT), and the Clean-Up Information (CLU-IN) electronic bulletin board. The Agency is also developing a fourth electronic information source, the Vendor Field Analytical and Characterization Technologies System (Vendor FACTS).

- ATTIC is a comprehensive information network on alternative methods of hazardous waste treatment, developed and maintained by ORD,

that is available through any modem-equipped IBM-compatible PC or Macintosh computer using standard communication software. The core of the on-line system is the ATTIC database, a relational database that contains technical information from a variety of sources, including EPA's SITE program, states, industry, RODs, and treatability studies. ATTIC also provides access to the Treatment Technology Database, which contains abstracts from literature on all types of treatment technologies and highlights literature viewed as best by experts; the Treatability Study Database, which provides performance information derived from treatability studies on technologies that remove contaminants from wastewaters and soil; the UST Database, which presents information on underground storage tank corrective actions, surface spills, emergency response, and remedial actions; and the Oil/Chemical Spill Database, which provides abstracts on treatment and disposal of spilled oil and chemicals. In addition, ATTIC allows immediate access to other disk-based systems such as VISITT and the Bioremediation in the Field Search System. Overall, FY94 statistics on ATTIC use clearly indicate an increasing demand for this valuable information service. In FY94, 10,308 calls were made to the ATTIC system, of which about 1,599 were first-time users. Callers copied (downloaded) information directly from ATTIC more than 2,900 times in FY94, indicating ATTIC's contents are valued and used.

- VISITT contains vendor-submitted performance and cost information. As of the end of FY94, VISITT 3.0 included information on 277 innovative treatment technologies offered by 171 developers and vendors. TIO provides this information on diskettes to interested potential users of innovative technologies. Since developing the system in FY91, TIO has distributed more than 10,000 copies of the system to requestors in over 60 countries.
- The CLU-IN electronic bulletin board is designed to serve project managers and others interested

in information about innovative remediation technologies. This bulletin board, which TIO funds and manages, offers a range of technology-related information that may be read on-line or down-loaded to a personal computer. In 1994, access to CLU-IN was enhanced by providing multiple pathways to connect to CLU-IN. Dial-in users can now connect directly by pushing a few keys on a standardized menu, and Internet users may access CLU-IN by a number of routes including direct TELNET access. To provide more information to the states, TIO included CLU-IN information for two new special interest groups: the owners or operators of leaking USTs and members of the Association of State and Territorial Solid Waste Management Officials.

- VendorFACTS, under development, will provide cost and performance and other related information submitted by vendors on 22 categories of measurement and monitoring technologies.

TIO has developed several publications that provide information on new developments and applications of innovative treatment technologies:

- In December 1993, TIO published a monograph titled, *Profile on Innovative Technologies and Vendors for Waste Site Remediation (Profile)*. The *Profile* documents the findings of a review of vendors who supply innovative technologies. The study was conducted to gain a better understanding the characteristics of the companies in this field.
- To assist innovative technology developers and investors in the soil and ground-water market, TIO published a benchmark survey that provides information on the future demand for remediation services. The survey, *Cleaning Up the Nations Waste Sites; Technology & Market Trends*, addresses site characteristics, market size, and other demand factors for the major waste site clean-up programs in the U.S. The market survey helped complete information on this fragmented market and address future demand for remediation services for all major clean-up

programs in the U.S., including Superfund, RCRA, UST, and other federal agency programs.

- The *Innovative Treatment Technologies: Annual Status Report* provides technical background information and information on the selection and use of innovative treatment technologies at Superfund sites. The report is designed to enhance communication among vendors, experienced technology users, and those who are considering using innovative treatment technologies to clean up contaminated sites. The September 1994 report contains information on almost 300 innovative technology projects at Superfund remedial and removal sites.
- *Tech Trends* and *Ground Water Currents* are two newsletters distributed by TIO that address soil treatment technologies and ground-water remediation technologies, respectively. These newsletters are published quarterly and are distributed to over 20,000 interested subscribers, including federal and state project managers, consulting engineers, academics, and technology users.
- The *Bioremediation Resource Guide* directs readers to resource documents, databases, hotlines, and dockets. The purpose of the guide is to assist technology users in accessing information on bioremediation technology and its applications.
- *Remediation Technologies Screening Matrix and Reference Guide, Version 2*, which was developed by TIO and members of the Federal Remediation Technology Roundtable, profiles 55 innovative and established technologies for the remediation of soil, sediment, sludge, ground water, and air/off gas treatment processes. This document presents a detailed discussion of the properties and behavior of five common contaminant groups including VOCs, SVOCs, fuels, inorganics, and explosives.
- Three treatment technology guides, *Physical/Chemical Resource Guide*, *Soil Vapor Extraction Guide*, and *Ground-Water Resource Guide*,

provide abstracts of guidance documents, overview/program reports, research studies, field demonstration results, and computer resources. These guides are designed to assist site project managers in screening and selecting innovative treatment technologies.

- The *Innovative Hazardous Waste Treatment Technologies: A Developer's Guide to Support Services (Third Edition)* was developed by TIO to provide information to technology developers and vendors on grant funding and technical assistance, incubators/test/evaluation facilities, and university-affiliated research centers offering technology development and evaluation services.

TIO also sponsored several traveling information booths that were sent to hazardous waste remediation conferences and other meetings around the country. These displays were major outlets for dissemination of EPA materials and database information on innovative remediation technologies.

Training and Continuing Education

In FY94, the Agency sponsored efforts to develop training resources and materials on technologies and site remediation.

- OSWER, in cooperation with the American Association of Environmental Engineers, continued work on monographs that detail specific innovative technologies. These monographs provide information to consulting engineers and other potential users about the use of state-of-the-art technology. In FY94, five monographs were completed containing state-of-the-practice design criteria and performance and cost information. The WASTECH steering committee is currently forming task groups to update and complete the monograph series.
- TIO, in cooperation with the Office of International Activities (OIA), developed a train-the-trainer course, *Principles of Hazardous Waste Site Ranking*, to provide fundamental environmental management information to the emerging democracies of central and eastern Europe. In 1994, TIO completed training for

instructors and government managers in Poland and transferred this training effort to the Polish government. TIO and OIA also negotiated with the government of Bulgaria and will begin training there. The primary objective of the training course is to assist the host government in developing programs to establish hazardous-site-remediation priorities. The training course helps participants identify potential threats to public health, welfare, and the environment; promotes effective use of limited resources and expertise; encourages public involvement and support in identifying and responding to waste-site problems; reassures those living near low-ranked sites that no immediate threat to their well-being exists; and ensures governmental accountability and consistency in program applications, nationally and internationally.

- TIO, with assistance from ORD, developed the Innovative Treatment Technologies Workshop in FY94 as an advanced level course for experienced On-Scene Coordinators and RPMs. The workshop provided an opportunity to understand the operation, applicability, adaptability, and cost and performance data for selected innovative treatment technologies for Superfund site remediation.

4.6 REPORT ON FACILITIES SUBJECT TO REVIEW UNDER CERCLA SECTION 121(c)

Certain remedies, such as containment remedies, allow hazardous substances, pollutants, or contaminants to remain on site if they do not pose a threat to human health or the environment. CERCLA Section 121(c) requires EPA to conduct a review of such sites at least every five years after the initiation of the RA to ensure that the remedy fully protects human health and the environment. CERCLA Section 121(c) also requires the Agency to submit a report to Congress that lists the facilities for which periodic

reviews were conducted, the results of all the reviews, and any action taken as a result of the reviews. FY94 was the fourth year in which sites were eligible for five-year reviews. A total of 39 sites required five-year reviews in FY94. Exhibit 4.6-1 contains the list of sites where five-year reviews were required in FY94. In addition, the following FY92 and FY93 five-year reviews were completed during FY94: Chisman Creek (VA) due FY92; Central City/Clear Creek (CO) due FY92; Denver Radium (CO) due FY92; GE-Moreau (NY) due FY93; and Tysons Dump #1 (PA) due FY93 for a total of 15 five-year reviews completed in FY94.

Of 14 sites that were reviewed during FY94, EPA determined that the remedies continue to protect human health and the environment at nine of the sites. At the remaining five sites, the Agency is continuing to implement the remedies required to protect human health and the environment. These sites include Delaware Sand & Gravel, L.A. Clarke and Sons, Southern Maryland Wood Treating, Strasburg Landfill, Tysons Dump (due FY93), and Washington County Landfill. EPA will continue to conduct future five-year reviews consistent with CERCLA Section 121(c) and Agency guidance.

To define the scope of five-year reviews and identify two types of reviews that may be conducted, the Agency issued a directive entitled *Structure and Components of Five-Year Reviews*. The directive defines “statutory reviews” as those expressly required by CERCLA Section 121(c). “Policy reviews” are defined as discretionary reviews that the Agency may choose to undertake in circumstances where they are not required by CERCLA. To reinforce the five-year review directive, EPA issued a fact sheet in August 1991 on five-year reviews.

The FY94 policy reviews were conducted at Sylvester (NH), Kimberton Site (PA), Middletown Road Dump Site (MD), Davie Landfill (FL), Pepper Steel & Alloys (FL), Cemetery Dump Site (MI), Charlevoix Municipal Well Field (MI), Kurt Manufacturing (MN), Tar Creek (Ottawa Co) (OK), and Triangle Chemical Co (TX). A total of 10 policy reviews were completed in FY94.

Exhibit 4.6-1
Sites At Which Five-Year Reviews Are Required Under CERCLA Section 121(c), Fiscal Year 1994

Site Name (State)	Region	Review Date
Baird & McGuire (MA)	1	
Laurel Park, Inc. (CT)	1	
Nyanza Chemical Waste Dump (MA)	1	11/10/93
Ottati & Goss/Kingston Steel Drum (NH)	1	12/15/93
Bog Creek Farm (NJ)	2	
Endicott Village Well Field (NY)	2	
Sealand Restoration (NY)	2	
Swope Oil & Chemical Co. (NJ)	2	
Upjohn Facility (PR)	2	
Vestal Water Supply 1-1 (NY)	2	
Fike Chemical (WV)	3	
Henderson Road Site (PA)	3	
Kane & Lombard Steel Drums (MD)	3	04/13/94
Delaware Sand & Gravel (DE)	3	09/30/94
L.A. Clarke & Sone (VA)	3	09/30/94
Southern Maryland Wood Treating (MD)	3	09/30/94
Strasburg Landfill (PA)	3	09/30/94
American Creosote Works (Jackson) (TN)	4	
Celanese Corp. (Shelby Fiber) (NC)	4	
Martin-Marietta-Sodyeco Inc. (NC)	4	
Stauffer Chemical Co. (Cold Creek) (AL)	4	
Stauffer Chemical Co. (LeMoyne Plant) (AL)	4	
Northwest 58th Street Landfill (FL)	4	03/02/94
Alpha Chemical Corp (FL)	4	05/16/94
Gold Coast Oil Corp. (FL)	4	
Johns-Manville Corp. (IL)	5	
Velsicol Chemical Corp. (Illinois) (IL)	5	
Washington County Landfill (MN)	5	01/06/94
Windom Municipal Dump (MN)	5	02/09/95
Waite Park Wells (MN)	5	
AT & SF (clovis) (NM)	6	
Bayou Sorrel Site (LA)	6	
Brio Refinery (TX)	6	
United Nuclear Corp. (NM)	6	
French Limited (TX)	6	
Lawrence Todtz Farm (IA)	7	
Monticello Radioactively Contamin (UT)	8	
Pacific Hide & Fur Recycling Co. (ID)	10	
Martin-Marietta Aluminum Co. (OR)	10	

